

Hydra-Safe Robotic Unit

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ABSTRACT

The Rocky Mountain Oilfield Testing Center (RMOTC) conducted a test on the Hydra-Safe Robotic Unit (HSRU) at DOE's Naval Petroleum Reserve #3. MELMc Inc, one of RMOTC's testing partners, created the HSRU. The HSRU is a portable, explosion proof, electrically powered, hydraulically driven machine that facilitates the installation of large and small bore safety valves during a blowout condition on a drilling rig. The machine is designed to roll out of the way during normal operations and provides a storage place for both the safety valve and its hex key handle. The HSRU works well with other rig equipment because it utilizes power commonly available on the rig. The HSRU is self-contained, requiring only an electrical cord and a low profile track system installed by drilling small holes in the rig floor for anchor bolts.

INTRODUCTION

When drilling oil and gas wells the formation pressure is counteracted by the hydrostatic head created by the mud systems fluid column in the well bore. The greater the formation pressure the heavier the mud system must be to maintain a balanced well bore. If the formation pressure is greater than the hydrostatic head pressure of the mud system, formation fluids (oil, water or gas) enter the well bore, causing the well to start flowing. Once the formation fluids enter the well bore the hydrostatic head pressure of the fluid column is reduced even further. If not caught and mitigated in a timely manner, a disastrous "blowout" situation can occur.

Various methods presently used in well control require safety valves to be picked up and inserted, manually, into the drill pipe by floor hands or are suspended by cable, chain or rope catline. Depending on the size of the drill pipe being used, these valves can weigh from 75 lbs. to 300 lbs. Drilling personnel are required to align and stab the safety valves into the top of the drill pipe while fluids and gasses are escaping. If pressures exceed 50 psi, these methods can result in serious injury to personnel either by movement of the suspended safety valve or by the blowing fragments from the well. The safety valve used during the test was 4 1/2" and weighed approximately 75 lbs.

The Hydra-Safe Robotic Unit was tested at RMOTC. This explosion proof, electrically powered, hydraulically driven device is a stand-by piece of equipment that mechanically lifts the safety valve, rolls into place, then lowers the valve to be spun up by hand. When not in use the device is rolled out of the way so normal operations can continue. The machine is hydraulically powered on the up stroke and on the down stroke, which allows the operator to apply a downward force as well as lift. Once the safety valve is installed in the drill pipe the safety valve can be disconnected from HSRU by loosening six bolts. The hydraulic cylinder can then lift the spinning bearing up and over the safety valve to be stored out of the way for normal killing procedures.

PROCEDURE

This test was carried out at RMOTC's drilling rig floor while the drilling rig was in for inspection. The drilling rig's electrical generator powered the HSRU with a 480 volt, 60 Amp service. A single piece of drill pipe was installed in the BOP stack with the female end of the drill pipe located 6 feet (the HSRU can reach up to 12 feet) above the rig floor. The pipe rams were closed around the drill pipe, providing an annular seal. A pressure truck was attached to the wellhead's 2-inch port and circulated the well until water was observed coming out of the drill pipe, mimicking a blowout condition. The HSRU was then activated.

THE FIRST TEST

The first test of the HSRU revealed design flaws that did not allow the valve to be spun up without the use of pipe wrenches. The HSRU was transported back to the shop for design modifications.

THE SECOND TEST

The second test proved that the modifications to the design were justified. The HSRU was able to pick up the safety valve, roll into place and lower the valve into the drill pipe. The safety valve was spun up by hand without any problems. Two people manned the HSRU. One man operated the push-button controller that raises and lowers the hydraulic cylinder. The other man rolled the device into place and closed the safety valve after the

joint was made up. The procedure was timed from the moment that the floorhand approached the HSRU to when the safety valve was shut in. The test was repeated for quality assurance. The two people that manned the HSRU were exposed to the machine for a short time during the first test and were given 5 minutes worth of training on how to operate the HSRU. The longest time it took to install, and close the valve was 1 minute 10 seconds.

CONCLUSIONS

The test proved that the Hydra-Safe Robotic Unit was an alternative to manually installing a safety valve. The HSRU provides a storage location for the safety valve and the hex key handle for closing the valve, which facilitates locating these items during an emergency. The roller system enables the HSRU to be stored out of the way during normal operations and activated quickly. The HSRU is powered by standard oil field rig equipment while keeping extra equipment to a minimum. This machine is not limited to one set distance above the rig floor. It is designed so that if the drill pipe is stopped at or below 10 feet above the rig floor the safety valve can still be installed. The safety valve can be easily removed from the HSRU by loosening several easily accessible bolts.

The HSRU can provide enough power to lift safety valves for even the largest of drill pipe in use today. The larger safety valves employed on drilling rigs today are cumbersome and could possibly result in an accident during an attempted installation with or without a winch line. With the HSRU these concerns are eliminated. It is so simple to operate even inexperienced personnel can be trained how to operate it in a short amount of time.

DISCLAIMER

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